NASA TECH BRIEF

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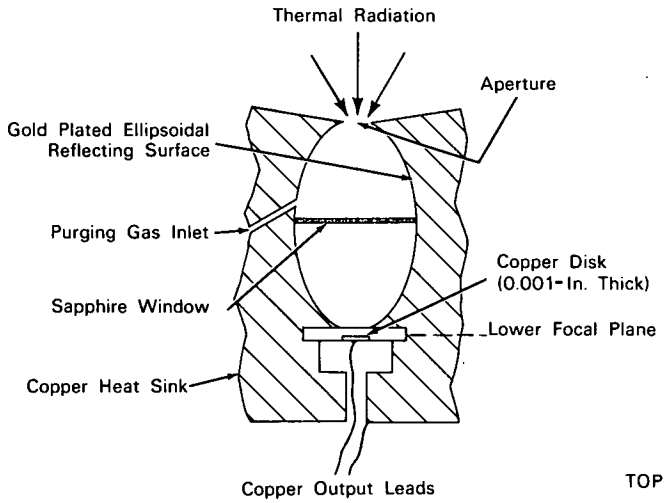
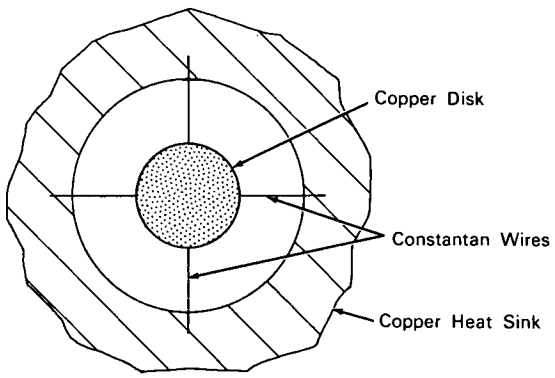
Wide-Angle Sensor Measures Radiant Heat Energy in Corrosive Atmospheres





TOP SECTION THROUGH LOWER FOCAL PLANE

The problem: Measuring radiant heat energy over wide incident angles (up to approximately 150°) in corrosive atmospheres such as rocket-motor exhaust gases. Conventional devices which can operate reliably in corrosive environments are restricted to narrow viewing angles (on the order of 30°).

The solution: A device with an ellipsoidal cavity having an aperture surrounding one focus of the ellipsoid and a distributed thermocouple sensor in a plane containing the second focus of the ellipsoid. The latter plane is perpendicular to the major axis of the ellipsoid.

How it's done: Thermal energy entering the aperture, where the upper focus of the ellipsoidal cavity is located, is reflected from the walls of the cavity toward the thermocouple sensor mounted on a support lying in the lower orthogonal focal plane of the ellipsoid. The walls of the cavity are imperfectly machined so that the sensor can be distributed over an area in the lower focal plane of the ellipsoid, instead of unrealistically attempting to confine it to a geometric focal point. The distributed sensor consists of a small copper disk with four uniformly spaced constantan wire junctions which are attached to a copper heat sink. Electrical output leads are connected to the copper heat sink and the constantan junctions. The amount of thermal energy entering the aperture per second can be calculated from the output voltage and the parameters of the system using a standard equation. The output voltage is substantially independent of the incident angle of the radiation falling on the copper disk. A sapphire window in the cavity protects the thermocouple sensor from corrosive gases. Purging gas admitted through an inlet in the side of the cavity provides an aerodynamic screen, serves to cool the device, and keeps the inside surfaces clean.

(continued overleaf)

Notes:

1. A related innovation is described in NASA Tech Brief B63-10004, April 1964. Inquiries may also be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama, 35812
   Reference: B65-10019

Patent status: NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

Source: The Boeing Company, under contract to Marshall Space Flight Center (M-FS-228)